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(71) Applicant
Milan Sevic,
Beograd, Kumanovska 34, Yugoslavia

(72) Inventor
Milan Sevic

(74) Agent and/or Address for Service
Vojin Sevic,
St Mary's Terrace 3, London W2

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(52) Domestic classification
F1F 1A4D EP

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GB 1374597

(58) Field of search
F1F

(54) **Sliding-vane rotary pump**

(57) Inlet and outlet ports for the working fluid are formed in stator end-walls, or "lids", *c* which can be turned about the axis of the rotor *d* so as to vary the nett displacement of fluid by the vanes.

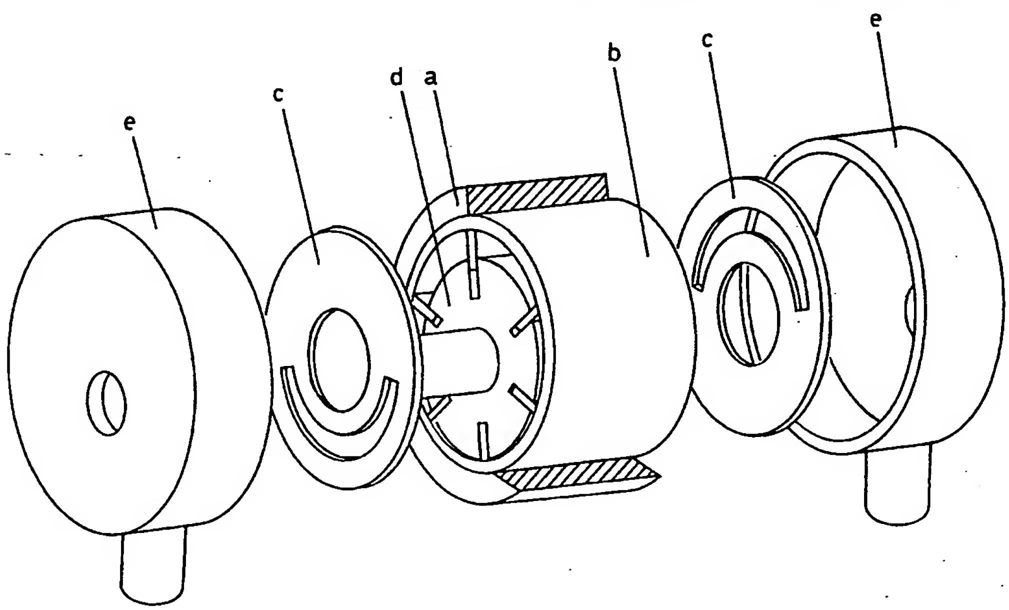

Fig. 1

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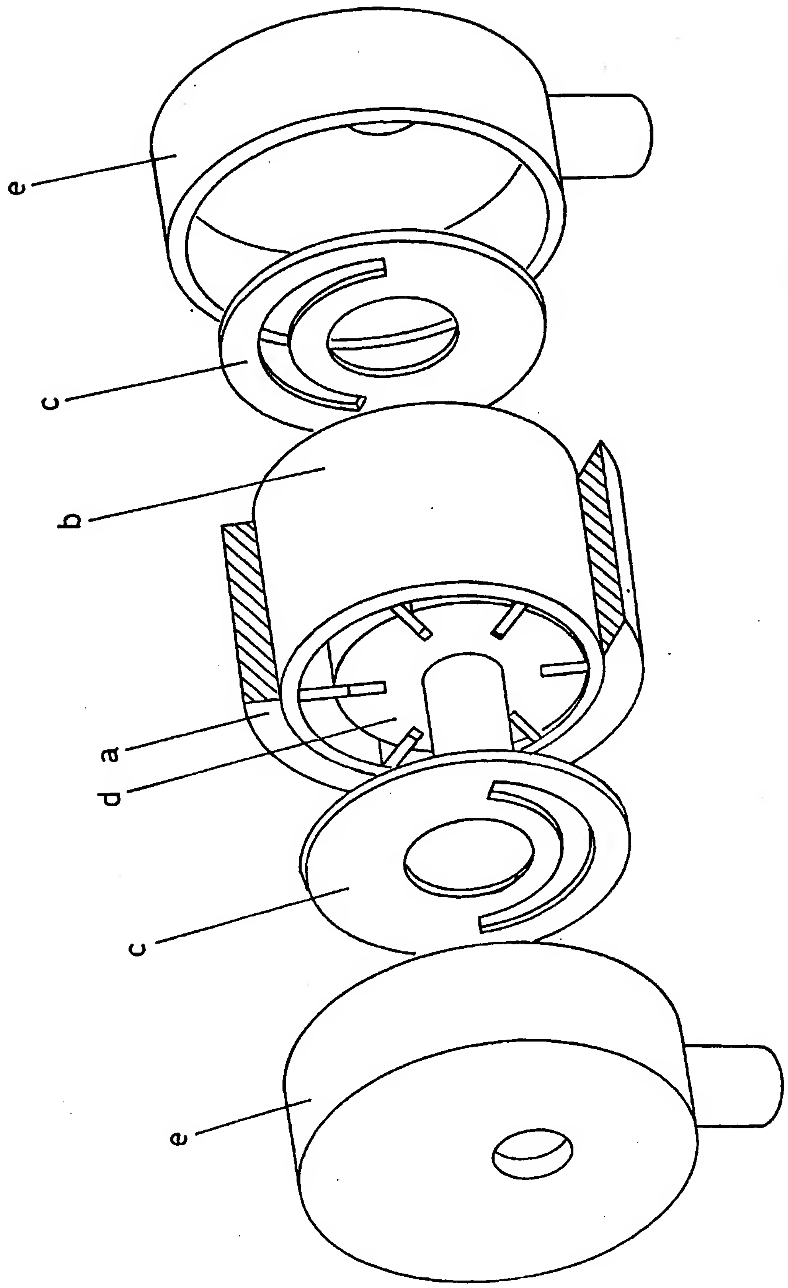


Fig.1

Fig. 2

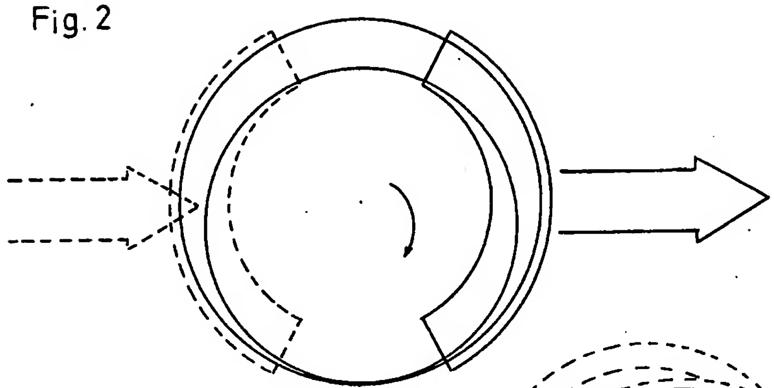


Fig. 3

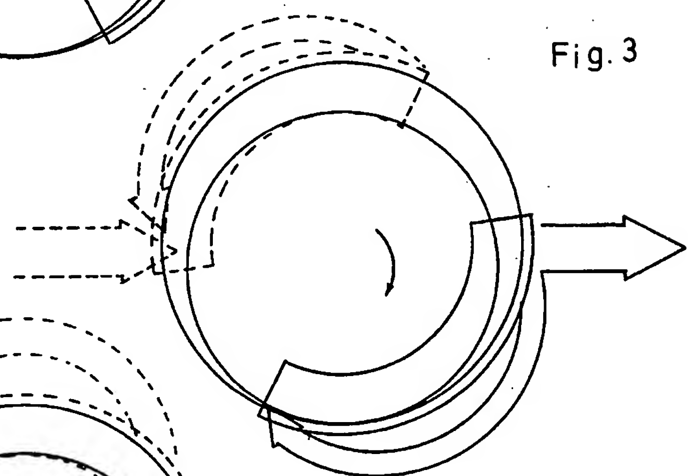


Fig. 4

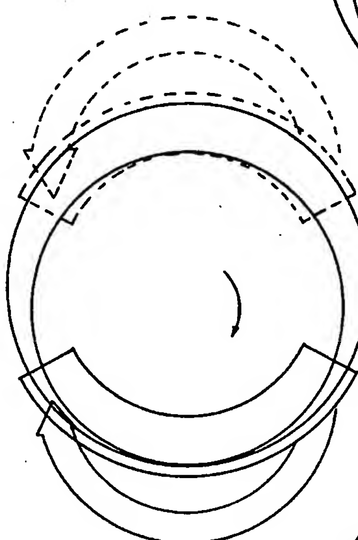


Fig. 5

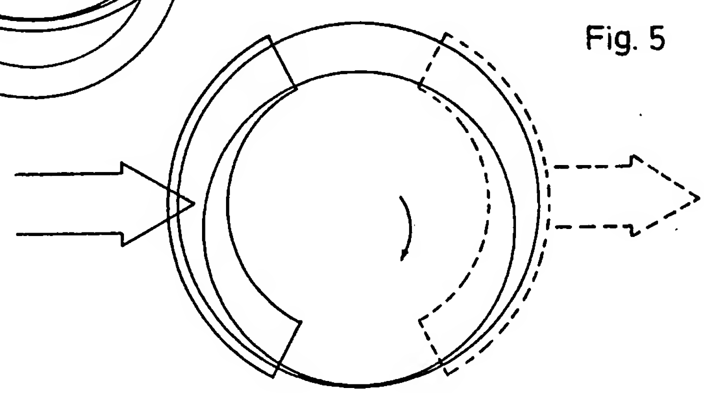


Fig. 6

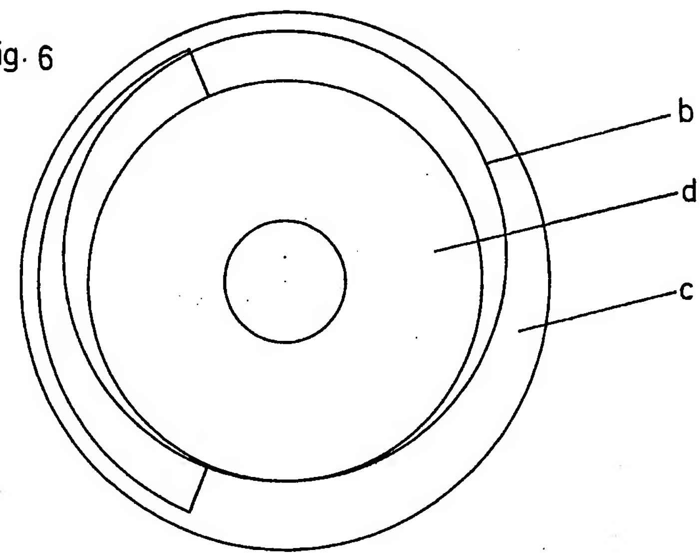


Fig. 7

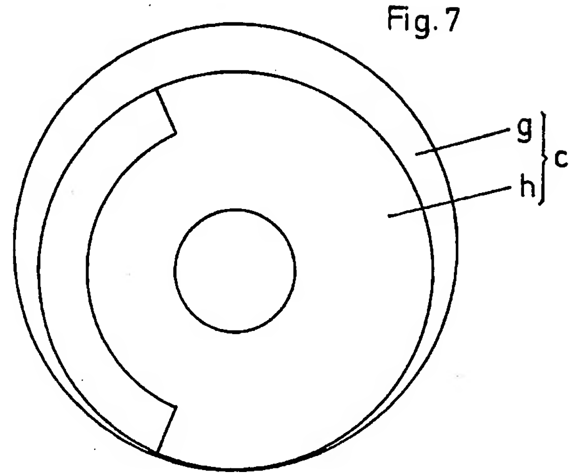


Fig. 8

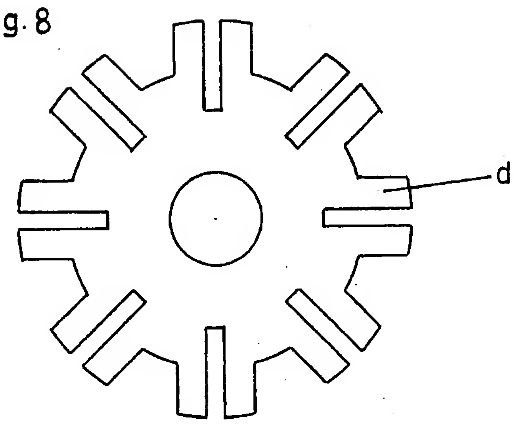
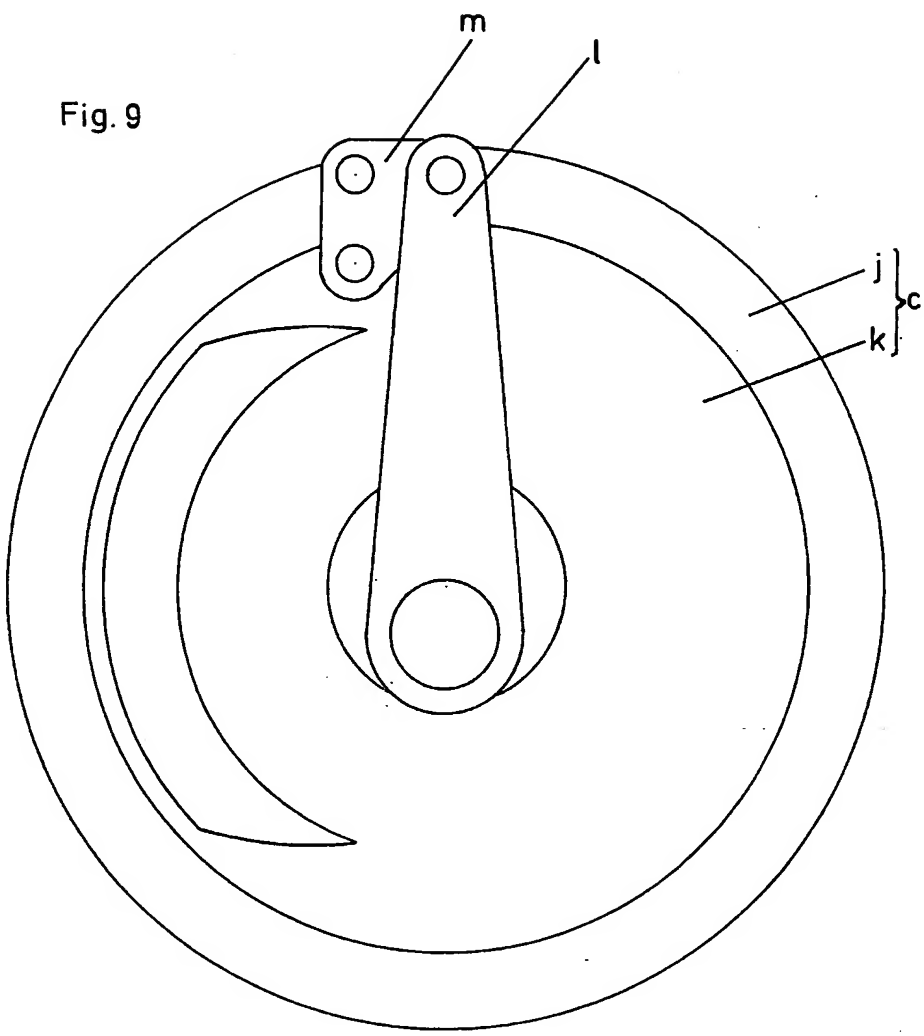


Fig. 9



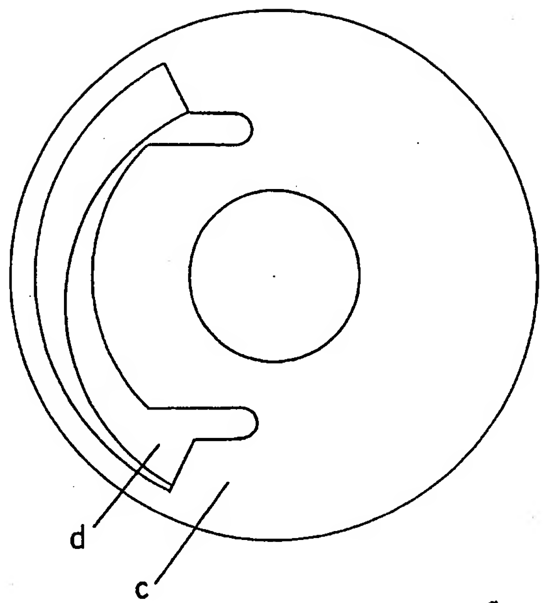
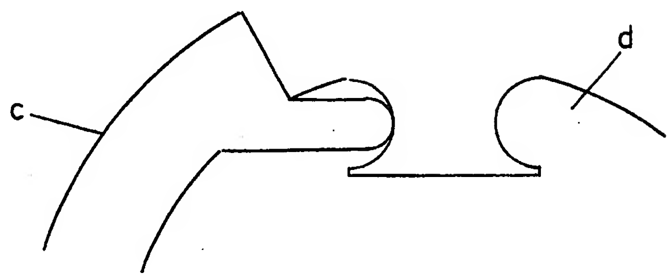


Fig. 10

Fig. 11



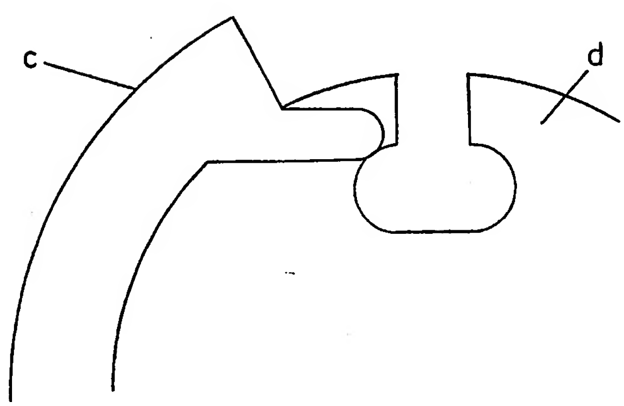


Fig. 12

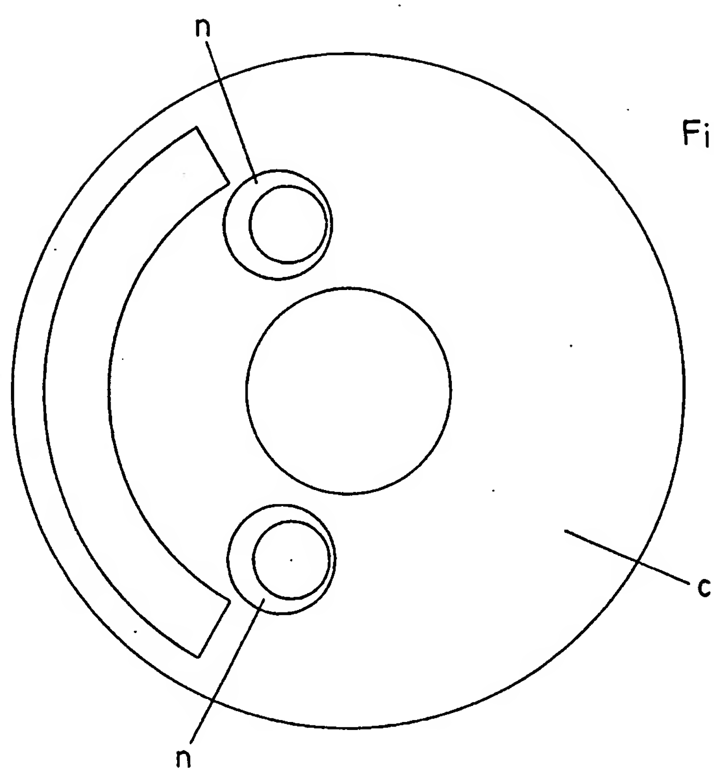


Fig. 13

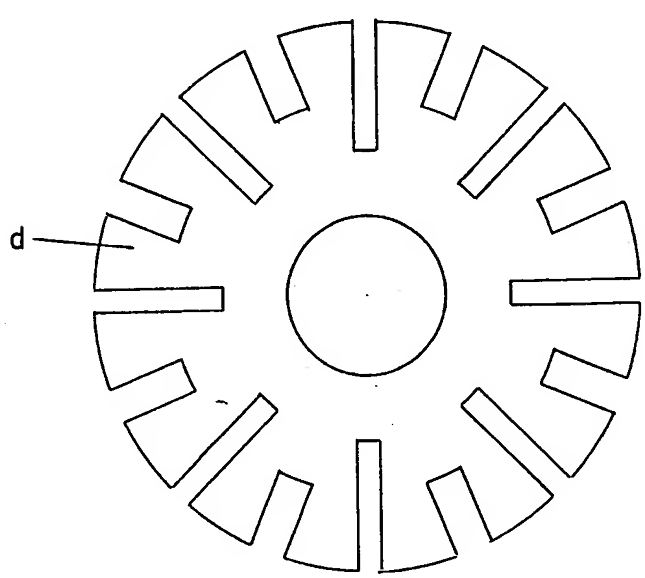


Fig. 14

SPECIFICATION

Variable flow vane pump

This invention relates to a variable flow vane pump.

Variable flow piston pumps exist, but their limiting factor is reciprocitating movement of the fluid inside the pump which limits the velocity of flow.

With this invention unidirectional flow of the fluid, although in a curved line, is accomplished, which enables greater velocity. The feature of the pump is that, with constant rotational speed of the rotor, rate of the flow can be varied continuously in both directions.

The integral part of the description are 6 Drawings which show:

1/6 exploded view, the essential parts
2/6 explanation of the functioning of the pump
3/6 the first basic constructional solution with two variants
4/6 the second basic constructional solution, first variant
5/6 the second basic constructional solution, second variant
6/6 the second basic constructional solution, third variant

The essential parts of the pump are /Drawing 1/6 Fig. 1/:

a. stator
b. cylinder
c. revolving cylinder lids with curved orifices
d. rotor with vanes and shaft
e. stator covers with shaft bearings and openings /one each/ for passage of the fluid
f. device for revolving lids "c" /not shown in the drawing as any suitable mechanism such as spur gearing can be used/

The pump has two flows: inner and outer. Inner flow in the cylinder "b" between the rotor and vanes "d" is constant ie. for each turn of the rotor the same quantity of fluid is expelled. That quantity, depending on the position of the lids "c", can pass through the openings on the stator cover "e" which makes outer flow, or return between the rotor vanes "d" which makes return flow.

The outer flow is equal to the difference of the inner and the return flows. When outer flow is maximal there is no return flow.

The curved orifices on the lids "c" provide inlet and outlet of the fluid in and out of the cylinder "b". The orifices on two lids are placed on opposite sides of diameter in relation to each other as shown in Fig. 1. The lids can be revolved simultaneously so that the orifices take different positions in relation to the offset of the rotor axis. Depending on the position of the lids "c" the chambers /which are defined with part of the rotor, part of the cylinder, two vanes and corresponding segments/ are opened and closed at different moments which results in the change of the outer flow. It is also obvious that the flow is axial.

The change of the outer flow is schematically shown in Drawing 2/6. The orifice and the fluid flow on one side of the cylinder "c" /and the rotor "d"/ are drawn in full lines and on the other side in dashed lines. Arrows mark direction of the rotor rotation.

The starting position /provisionally called so for description/ of the orifices /ie. the lids/ is shown in Fig. 2. In this position the whole quantity of the fluid passes through the pump in one direction. In Fig. 3 the orifices are revolved 45° in relation to starting position. Now the part of the expelled fluid returns among the vanes and another part flows through the openings on the stator cover "e". In any other position of the lids "c", between 4 extremities /2 zero flows, 2 maximal flows in opposite directions/, outer flow is smaller than maximal and greater than zero because some quantity of the expelled fluid returns through the orifices into the chambers /the return flow/.

In Fig. 4 the orifices are revolved 90° in relation to the starting position. Now fluid flows only inside the pump. Outer flow is zero.

In Fig. 5 the orifices are revolved 180°. Outer flow is maximal but in opposite direction as regarding the starting pos.

Revolving the orifices for 270° leads again to zero outer flow and revolving for 360° leads to the starting position.

The change of outer flow is continuous. It is achieved in both directions of lids "c" revolution. Functioning of the pump does not depend on the direction of the rotor rotation. The pump can be used as motor.

Constructional solutions

For revolving of the cylinder lids "c" two basic solutions are possible:

I revolving around the axis of the rotor "d"
II revolving around the axis of the cylinder "b"

Basic solution I
revolving of the lids "c" around the axis of the rotor "d"

In this solution the cylinder "b" is fixed and makes entirety or is firmly attached to the stator "a"

A. In Drawing 3/6 Fig. 6 a solution is shown where the lids "c" cover and overspan bases of the cylinder "b".

B. In Drawing 3/6 Fig. 7 a solution is shown where the lid "c" consists of two parts: immobile "g" firmly attached to the cylinder "b" and mobile "h" which is concentric with the rotor "d". Since mobile part "h" covers rotor base only, channels for fluid flow must be made on the rotor eg. as in Fig. 8.

Basic solution II
revolving of the lids "c" around the axis of the cylinder "b"

In this solution the lids "c" are firmly attached to the cylinder "b" and revolve together.

C. Lid "c" consists of two parts /see Drawing 4/6 Fig. 9/. Part "j" is firmly attached to the cylinder "b" and part "k", concentric with part "j" is mobile in relation to part "j" and includes curved orifice of particular shape. This shape depends on the constructional characteristics of the pump. It is essential for this solution that possibility of angular movement of part "k" in relation to the part "j" is provided for the same angle in both directions. The value of that angle is determined by the shape of the curved orifice ie. by the constructional characteristics of the pump.

The part "k" is actuated by the lever "l" which is connected on one end to the rotor shaft and on the other end to the bell-crank "m". The bell-crank rotates around the pin affixed to the part "j", its other crank actuates the part "k".

D. In Drawing 5/6 Fig. 10 the one piece lid "c" is shown. The ends of the orifices on the lids "c" enter into the bases of the rotor in all positions of the lids. On this ends opening and closing of the fluid flow, from and into the chambers, is performed.

In Fig. 11 are shown: profiled channel on the rotor "d" and spcially shaped end of the orifice on the lid "c" which enable opening-closing of the fluid flow for 180° of the lid "c" revolution. For the next 180° the profile on the rotor channel is shown in Fig. 12. This solution does not provide functioning for the full circle of the lids revolution, but only for the half. Since the orifices on the lids are situated on the opposite sides of diameter this solution should be executed with one side of the rotor as in Fig. 11 and the other as in Fig. 12. This would enable functioning of the pump for 180° of the lid revolutin: for maximal flow in one direction, over zero flow, to maximal flow in opposite direction.

Note: shapes of the ends of the orifices and the rotor channels are interchangeable.

E. In Drawing 6/6 Fig. 13 the lid "c" containing two rotating inserts "n" is shown. Each insert has eccentric circular hole in it. Inserts remain permanently on the rotor base. For this solution the rotor "d" should look as in Fig. 14 ie. to have right-angled channels for the flow of the fluid. Opening-closing of the fluid flow from and into the chambers is performed by the eccentric holes on the parts "n". Parts "n" make one circle per one circle of lids "c" revolution. That is achieved by means of the planetary gearing. This solution enables functioning of the pump for 360° of the lids "c" revolution.

CLAIMS

1. A variable flow vane pump comprising following basic parts: stator "a", cylinder "b", revolving cylinder lids with curved orifices "c", rotor with vanes and shaft "d", stator covers "e" /all in Drawing 1/6 Fig. 1/ and device to revolve lids "c".

2. A variable flow vane pump as claimed in Claim 1 wherein the cylinder lids "c" revolve around the axis of the rotor and overspan bases of the cylinder "b".

3. A variable flow vane pump as claimed in Claim 1 wherein the cylinder lids "c" revolve around the axis of the rotor but cover only bases of the rotor "d", the rotor has channels made on it.

4. A variable flow vane pump as claimed in Claim 1 wherein the cylinder lids "c" revolve around the axis of the cylinder together with the cylinder "b". Lids "c" consist of two parts: peripheral part is firmly attached to the cylinder "b" while central part with curved orifice is mobile in relation to the peripheral for defined angle in both directions which is executed by the system of levers.

5. A variable flow vane pump as claimed in Claim 1 wherein the cylinder lids "c" revolve around the axis of the cylinder together with the cylinder "b". The curved orifices on the lids "c" have specially shaped ends which permanently remain on the bases of the rotor "d". The rotor itself has specially profiled channels which are different for two sides of the rotor, or alternatively shapes of ends on one lid are different to the other, with profil of channels on rotor being the same on both sides.

6. A variable flow vane pump as claimed in Claim 1 wherein the cyilnder lids "c" revolve around the axis of the cylinder together with the cylinder "b". Each lid "c" contains two rotating inserts on the ends of the curved orifice. The inserts have eccentric circular hole. The inserts are rotated by means of planetary gearing.

7. A variable flow vane pump substantially as described herein with reference to Figs. 1–14 of the accompanying Drawings 1/6–6/6.

CLAIMS

Superseded claims 1 to 7.

New or amended claims:–

1. A varable flow vane pump comprising following basic parts: stator "a", revolving cylinder "b" with firmly attached lids "c" which have curved orifices on them, rotor with vanes and shaft "d", stator covers "e" (all in Drawing 1/6, Fig. 1) and a device to revolve the cylinder "b".

2. A variable flow vane pump as claimed in Claim 1 wherein the lids "c" consist of two parts: central and peripheral (Fig. 9) The orifice is on the central part which is mobile in relation to the cylinder-peripheral part for a

defined angle in both directions. This is achieved by the system of levers.

3. A variable flow vane pump as claimed in Claim 1 wherein the curved orifices on the lids "c" have specially shaped ends which permanently remain on the bases of the rotor "d" (Fig. 10). The rotor itself has specially profiled channels between each two vane slots.

4. A variable flow vane pump as claimed in Claims 1 and 3 wherein the shape of the ends of orifices on the lids "c" is same on both lids, while profiles of the channels on the bases of the rotor "d" are different on one base in relation to the other (Fig. 11 and 12).

5. A variable flow vane pump as claimed in Claims 1 and 3 wherein the shape of the ends of orifice on one lid "c" is different in relation to the other lid, while profile of the channels on the rotor bases is same on both bases.

6. A variable flow vane pump as claimed in Claim 1 wherein each lid "c" contains two rotating inserts "n" on the ends of the curved orifice (Fig. 13). Each insert has an eccentric circular hole. The inserts are rotated by means of planetary gearing. The rotor "d" has right angled channels between each two vane slots (Fig. 14).

7. A variable flow vane pump substantially as described herein with reference to Figs. 1–5 and 9–14 of the accompanying drawings.

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